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Martins et al.

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(54) **INNER SEAL RING FOR ROLLING MILL OIL FILM BEARING**

(75) Inventors: **Armando S. Martins**, Cumberland, RI (US); **Dennis Shriner**, Worcester, MA (US); **Peter N. Osgood**, Upton, MA (US)

(73) Assignee: **Morgan Construction Company**, Worcester, MA (US)

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(52) **U.S. Cl.** **277/353**; 277/552; 384/485; 72/247

(58) **Field of Search** 277/352–353, 277/402, 551–552, 560, 562, 566; 72/236–237, 247; 384/485–486

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4,389,053	A	*	6/1983	Innis et al.	277/402
4,455,856	A	*	6/1984	Salter et al.	72/236
4,586,720	A	*	5/1986	Simmons et al.	277/565
5,478,090	A	*	12/1995	Simmons et al.	277/423
6,053,501	A	*	4/2000	Innis et al.	277/571
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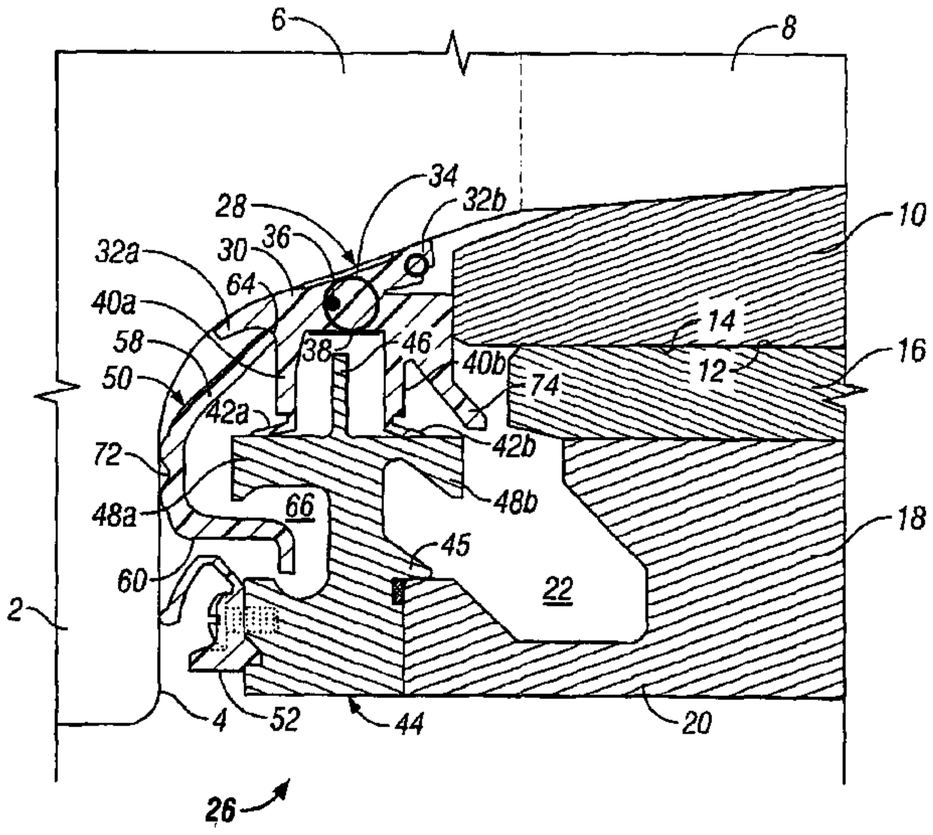
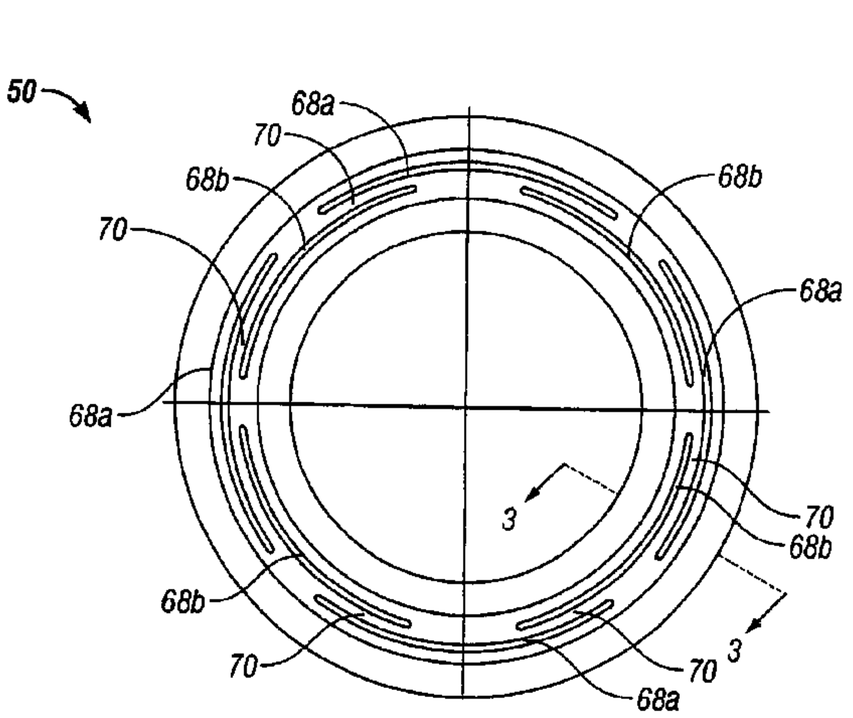
Primary Examiner—Alison Pickard
Assistant Examiner—Vishal Patel
(74) *Attorney, Agent, or Firm*—Gauthier & Connors

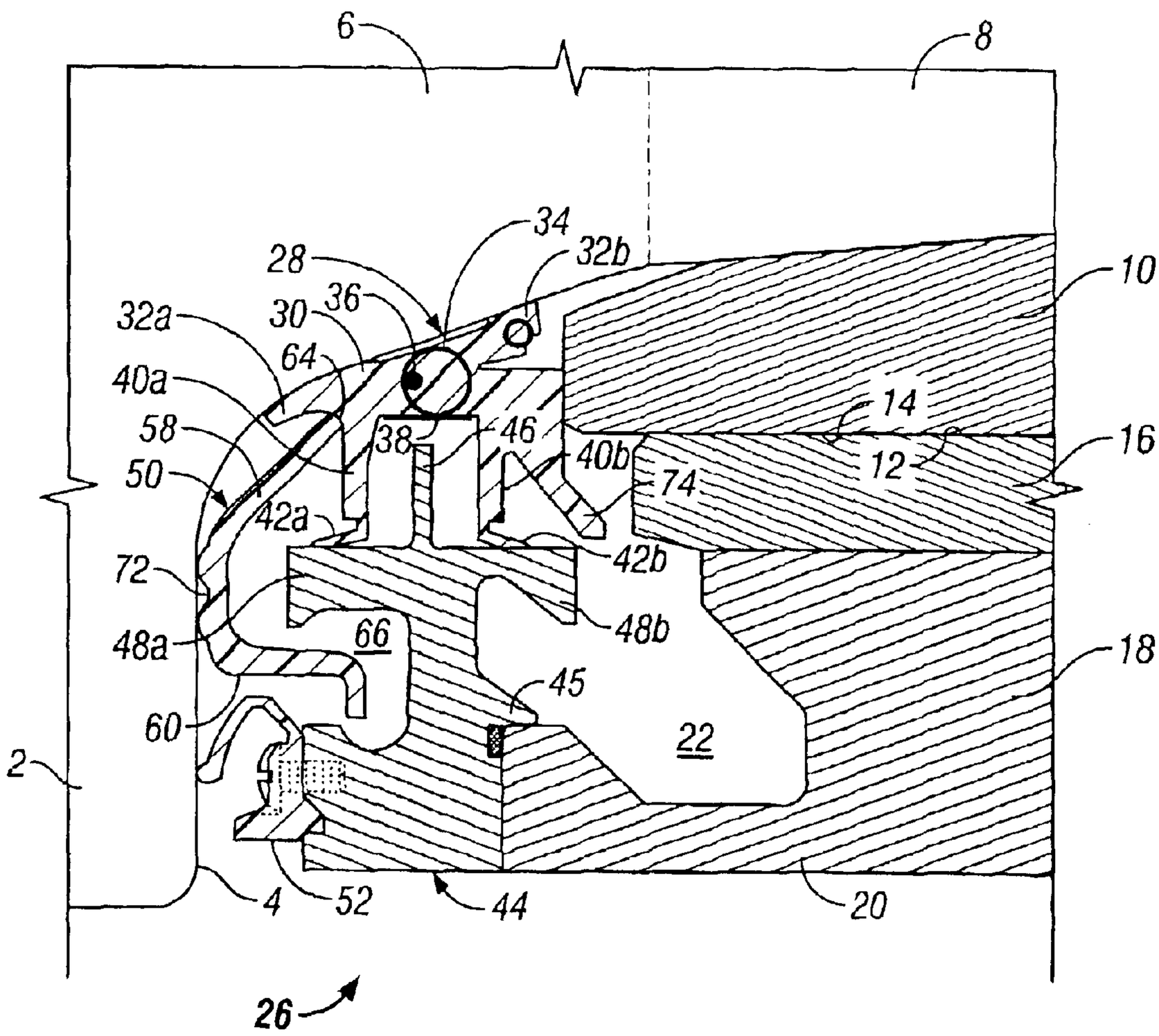
(57) **ABSTRACT**

An inner seal ring is disclosed for use in an oil film bearing for a roll in a rolling mill. The roll has a neck with an intermediate section tapering from an end face to a reduced diameter end section contained within a sleeve. The sleeve is fixed in relation to the roll neck and is journalled for rotation in a bushing contained within a chock. A flexible neck seal is mounted on the intermediate section of the roll neck for rotation with the roll within a seal end plate fixed to the chock. The inner seal ring comprises a circular midsection with an annular face on one side and with inner and outer flanges projecting from an opposite side. The inner flange is configured to engage the neck seal, the outer flange is configured to coact in spaced relationship with the seal end plate to define a first labyrinth, and the annular face is contoured to coact in an abutting relationship with the roll end face in defining a second labyrinth.

2 Claims, 2 Drawing Sheets






6
8
34
32b
28
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30
32a
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40a
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42a
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2
4
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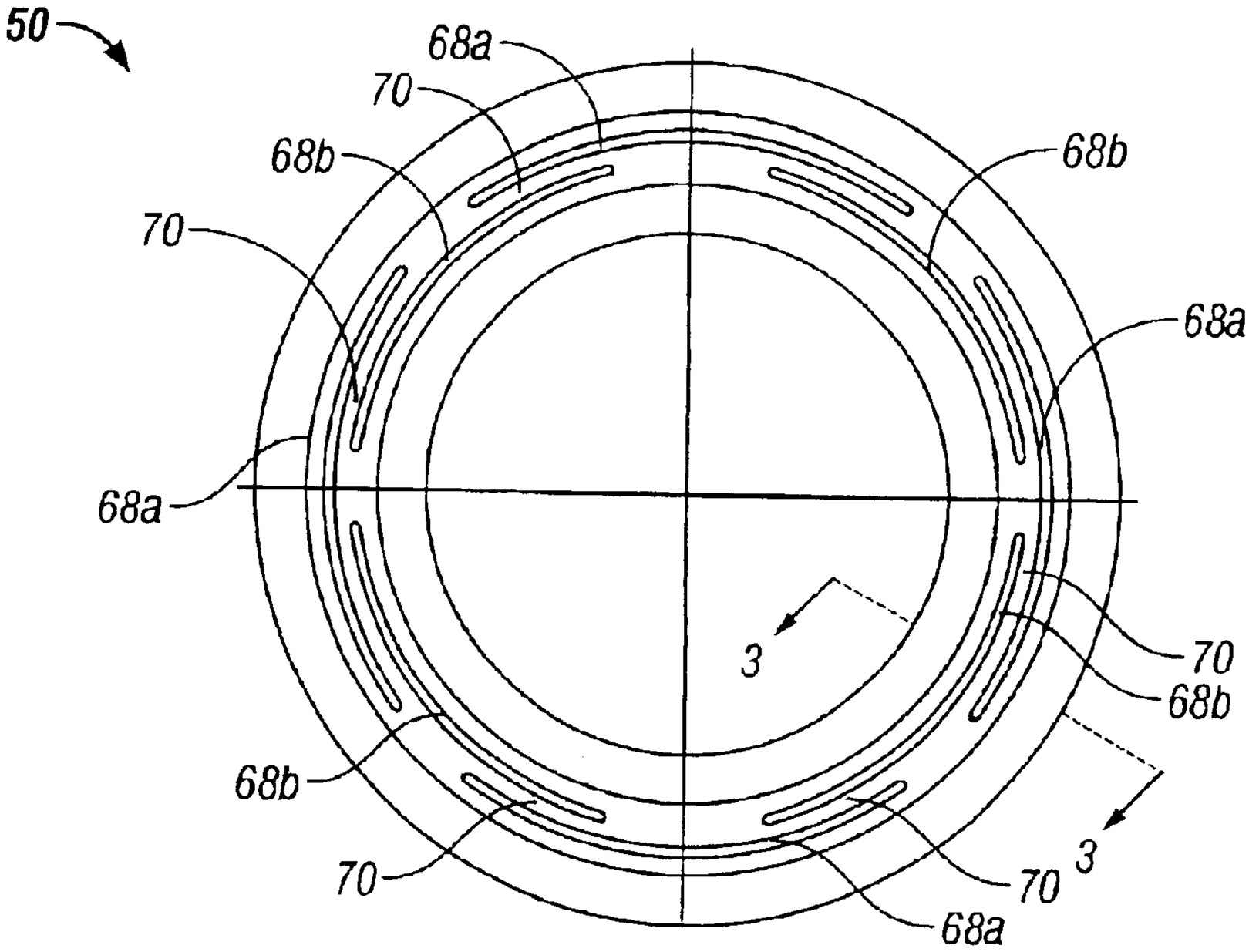
46
42b
48b
45
22
18
20

FIG. 1


50
68a
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68b
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3
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68a
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68b
3
70
68a

FIG. 2

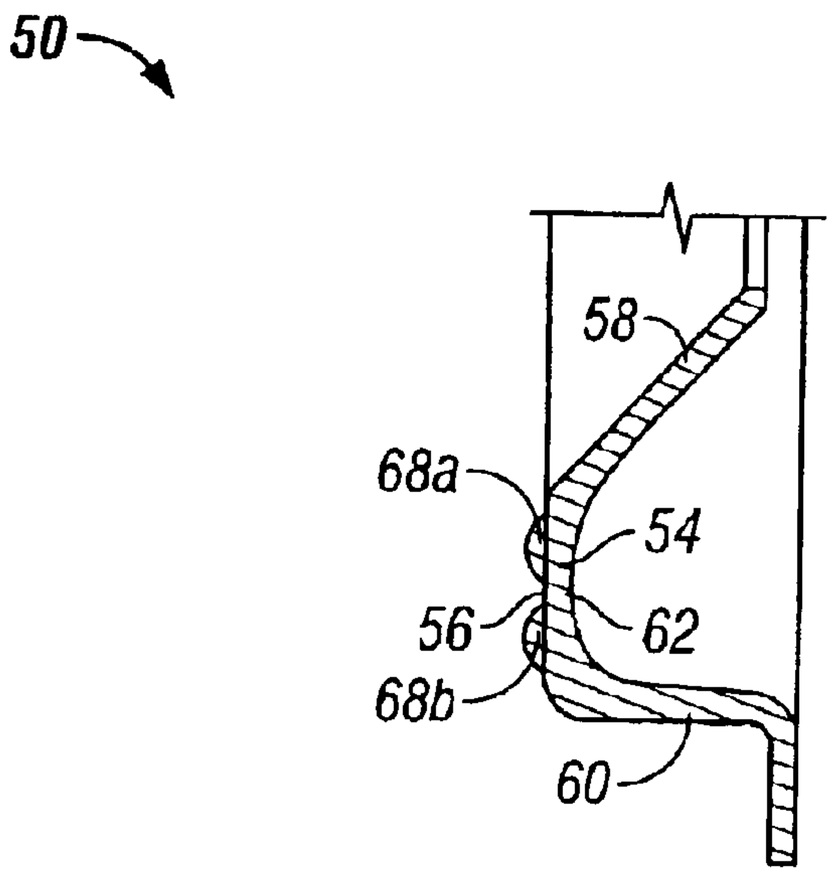
50
58
68a
54
56
62
68b
60

FIG. 3

INNER SEAL RING FOR ROLLING MILL OIL FILM BEARING

BACKGROUND DISCUSSION

1. Field of the Invention

This invention relates generally to oil film bearings for rotatably supporting the necks of rolls in a rolling mill, and is concerned in particular to an improved inner seal ring for the seal assemblies of such bearings.

2. Description of the Prior Art

Known seal assemblies for rolling mill oil film bearings are disclosed, for example, in U.S. Pat. No. 5,478,090 (Simmons et al.); U.S. Pat. No. 4,455,856 (Salter, Jr. et al.); and U.S. Pat. No. 4,389,053 (Innis Jr. et al.). These seal assemblies include inner seal rings configured to engage a flexible seal surrounding the roll neck and to coact with other seal components in defining a labyrinth designed to exclude cooling water and entrained dirt and mill scale from penetrating into the bearing. The inner seal rings are typically formed from aluminum and are provided with circumferentially spaced rubber bumpers arranged to abut an end face of the roll. The aluminum is easily damaged by being bent or dented, and its stiffness can disadvantageously deform the flexible neck seal. Moreover, the rubber bumpers create a space for water ingress between the inner seal ring and the roll end face.

SUMMARY OF THE INVENTION

In accordance with the present invention, the inner seal ring is integrally molded of a plastic material, with an annular face contoured to coact in an abutting relationship with the roll end face to define a second labyrinth for additionally impeding water ingress onto the bearing. The plastic material has increased resilience and flexibility, and as such is less likely to deform the neck seal, or to suffer damage by being dented or permanently bent out of shape.

These and other features and advantages of the present invention will now be described in greater detail with reference to the accompanying drawings, wherein:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a cross-sectional view through a seal assembly embodying an inner seal ring in accordance with the present invention;

FIG. **2** is a side view of the inner seal ring showing its contoured annular face; and

FIG. **3** is a sectional view on an enlarged scale taken along line **3**—**3** of FIG. **2**.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

Referring now to the drawings, and with initial reference to FIG. **1**, there is shown at **2** a roll having and end face **4** and a roll neck with a tapered intermediate section **6** leading to a more gradually tapered end section **8**. A sleeve **10** is mounted on the tapered end section **8** and is fixed relative to the roll neck by conventional means (not shown) for rotation therewith. The sleeve **10** has an external bearing surface **14** journalled for rotation within an interior bearing surface **12** of a fixed bushing **16** enclosed by a chock **18**. The sleeve **10** rotates with the roll while the chock **18** and the bushing **16** remain stationary. Oil is continuously supplied at a rate of flow sufficient to provide for a hydrodynamically maintained

film between bearing surfaces **12**, **14** at the bearing load zone. An axial extension **20** of the roll chock forms a sump **22** in which the oil emerging from between the bearing surfaces **12**, **14** is continuously collected. The oil is drawn away from the sump through a suitable piping connection (not shown) to be recycled in the lubrication system of the mill.

Under so-called "wet" rolling applications, cooling water is continuously flooded over the roll **2** and down over its end face **4**. In spite of the centrifugal forces which tend to throw the water off the roll, some of the water tends to work its way along the roll neck in the direction of the bearing. The objective of the seal assembly generally indicated at **26** and the flexible neck seal **28** which forms a part of the seal assembly, is to prevent the cooling water from reaching and contaminating the bearing oil while at the same time preventing loss of oil from the bearing.

The neck seal **28** includes a flexible circular seal body **30** with lips **32***a*, **32***b* in sealing contact with the tapered section **6** of the roll neck. The neck seal **28** is molded of a suitable resilient rubber-like material. Preferably, the seal body **30** is internally reinforced by an embedded combination of a coiled spring **34** and a steel cable **36** as described in U.S. Pat. No. 3,330,567.

The seal body **30** is encircled by a metal retaining band **38** which is parallel to the rotational axis of the roll **2** when the neck seal is in its mounted position as shown in FIG. **1**. A pair of resilient inboard and outboard flanges **40***a*, **40***b* are integral with and extend radially outwardly from the seal body **30** at opposite ends of the retaining band **38**. The flanges **40***a*, **40***b* are advantageously provided with angled oppositely facing lips **42***a*, **42***b*.

The seal assembly also includes a rigid seal end plate **44** having a circular body **45** fixed to the axial extension **20** of the chock **18**. The seal end plate has a radially inwardly extending rigid flange **46** that is perpendicular to the rotational axis of the roll **2**. The inner edge of flange **46** is spaced radially from the exterior surface of the retaining band **38** on the flexible seal body. The seal end plate further includes inboard and outboard shoulders **48***a*, **48***b* extending axially in opposite directions from the rigid flange **46**. The shoulders **48***a*, **48***b* surround the resilient seal flanges **40***a*, **40***b* and are arranged to be sealingly contacted by the angled lips **42***a*, **42***b*.

The seal assembly **26** further includes a seal inner ring **50** in accordance with the present invention surrounded by a resilient water guard **52**.

With reference additionally to FIGS. **2** and **3**, it will be seen that the inner seal ring **50** is molded from a plastic material, preferably a blend of polyimide and urethane or the like, and includes a circular midsection **54** with an annular face **56** on one side, and with inner and outer flanges **58**, **60** projecting from an opposite side **62**. As shown in FIG. **1**, the inner flange **58** is configured to engage the neck seal **28** as at **64** and the outer flange **60** is configured to coact in spaced relationship with the seal end plate **44** in defining a first labyrinth **66**.

The annular face **56** is contoured with concentric sets of partially circular ridges **68***a*, **68***b*. The ridges **68***a*, **68***b* are offset both radially and circumferentially, with their overlapped segments separated by grooves **70**.

Again, as shown in FIG. **1**, the ridges **68***a*, **68***b* are configured to coact in an abutting relationship with the roll end face **4** in defining a second labyrinth **72**.

During a rolling operation, the inner seal ring **50**, flexible neck seal **28** and sleeve **10** rotate with the roll, whereas the

water guard **52**, seal end plate **44**, chock **18** and bushing **16** remain stationary.

Lubricating oil will constantly emerge from between the bearing surfaces **12**, **14**. Most of this oil will be turned back by a flinger **74** on the rotating neck seal and will thus be returned to the sump **22**. Oil that succeeds in passing around the flinger **74** will be turned back by the sealing contact of the lip **42**(*b*) of the outboard neck seal flange **40***b* with the outboard shoulder **48***b* of the seal end plate.

Most of the externally applied coolant will be deflected away from the bearing interior by the water guard **52**. Any coolant that succeeds in penetrating by the water guard will be trapped in the first labyrinth **66** from which it will be drained via a drainage port (not shown) in the seal end plate **44**.

The second labyrinth **72** formed by the ridges **68***a*, **68***b* and the roll end face **4** will serve to effectively prevent coolant from penetrating between the roll end face and the annular face **56** of the inner seal ring **50**.

In light of the foregoing, it will now be apparent to those skilled in the art that various changes may be made to the embodiment herein chosen for purposes of disclosure, without departing from the scope of the claims appended hereto. By way of example only, the configuration, number and spacing of the ridges on the annular face **56** of the inner seal ring may be changed to suit particular bearing sizes and/or bearing applications. While the materials specified for the inner seal ring are preferred, other equivalent materials may be substituted.

We claim:

1. An inner seal ring for use in an oil film bearing for a roll in a rolling mill, said roll having a neck with an intermediate section tapering from an end face of the roll to a reduced diameter end section contained within a sleeve, the sleeve being fixed in relation to the neck and being journalled for rotation in a bushing contained within a chock, with a flexible neck seal mounted on the intermediate section of the roll neck for rotation with the roll within a seal end plate fixed to the chock, said inner seal ring comprising: a circular midsection with an annular face on one side and with inner and outer flanges projecting from an opposite side, said annular face having a plurality of ridges separated by grooves, said ridges being partially circular and offset both radially and circumferentially, said inner flange being configured to engage the neck seal, said outer flange being configured to coact in spaced relationship with the seal end plate to define a first labyrinth, and said ridges on said annular face being contoured to coact in an abutting relationship with the roll end face in defining a second labyrinth.

2. The inner seal ring of claim **1** wherein said circular midsection and said inner and outer flanges are integrally molded from a plastic material.

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